Additions to the Catalogue of the Lepidoptera of Kansas, by Prof. F. H. Snow.

Observations of the Botany of Kansas, with list of Plants observed since last year, by Prof. J. H. Carruth.

Descriptions of the several stages of Plagiodera scripta Fabr.—by William Osburn.

Remarks on some Characteristic Fossils of Western Kansas, by Prof. B. F. Mudge.

On the Hot Bluffs of the Missouri River in Nebraska, by Prof. W. K. Kedzie.

On the San Juan Mining Region, by Dr. W. H. Saunders.

On the Habits of certain Larvae, by Geo. F. Gaumer.

Catalogue of the Mammals of Kansas, with notes, by Prof. M. V. B. Knox.

On the Ozone in the Atmosphere of Kansas, by Prof. W. K. Kedzie.

Additions to the Catalogue of Kansas Birds, by Prof. F. H. Snow.

On the Chalk of Kansas, by Prof. G. E. Patrick.

On the Larva and Chrysalis of the Sage sphinx (Sphinx lugens Walker), by Prof. F. H. Snow.

The following officers were elected for the ensuing term of one year:

President—Frank H. Snow.

Vice Presidents—B. F. Mudge, J. H. Carruth.

Secretary—Joseph Savage.

Treasurer—R. J. Brown.

Curators—F. H. Snow, W. K. Kedzie, E. A. Popenoe.

The following commissions were also appointed:

Geology—B. F. Mudge, M. V. B. Knox.

Chemistry and Mineralogy—W. K. Kedzie, G. E. Patrick.

Mammalogy—M. V. B. Knox.

Ornithology—F. H. Snow.

Entomology: Lepidoptera—F. H. Snow; Coleoptera—E. A. Popenoe; Hymenoptera—William Osburn; Diptera—George F. Gaumer.

Botany—J. H. Carruth, John Wherrell.

Engineering—F. W. Bardwell, William Tweeddale.

Meteorology—J. D. Parker.

Philology—D. H. Robinson.

Committee on Publication—B. F. Mudge, Chairman; A. Gray, F. H. Snow.

Committee on Local Arrangements—P. McVicar, Chairman; A. H. Thompson, E. A. Popenoe.

The Society adjourned to meet in 1876, in Topeka—the date to be announced by the Executive Committee.

E. A. POPENOE, Secretary pro tem.

OZONE IN KANSAS ATMOSPHERE

By Prof. Wm. K. Kedzie, of the State Agricultural College.

We hear much from every quarter of the healthfulness so generally characteristic of the climate of Kansas; and no person long resident within the State can have failed to be strongly impressed by the unmistakable health producing and health-sustaining features of Kansas atmosphere.

None of us need to be reminded of the general immunity which we enjoy from the inroads of bronchial and lung difficulties; nor to recall the startling recoveries which we have all witnessed when invalids are brought into our midst completely prostrated by these maladies as they prevail in more eastern localities. I doubt not every thoughtful student has carefully sought for the adequate causes which have brought about so admirable a sanitary result. Our altitude above the sea is considerable, and yet is manifestly insufficient to account for so well marked a condition. Our atmosphere is proverbially a dry one; but an arid climate is not necessarily a healthful one. Now it is far from being the object of this paper to attempt any solution of this interesting problem, in which so many elements must obviously enter, and in the discussion of which any unanimity of opinion is well-nigh impossible. It is simply my desire to call your attention as a possible explanation of our climatic superiority, to the existence of an element which has thus far received little attention among us: the Ozone, everywhere prevalent in Kansas atmosphere. Nor is it any part of my intention to present here any elaborate discussion of the nature of this element nor of its supposed relations to the conditions of health and disease. This element has now been known to chemists barely thirty-five years, and yet ever since its discovery in 1840, by Schonbein, of Basle, it has probably received from chemists more universal attention with less satisfactory results than any other one body. It is only recently that a prominent member of the British Association pronounced any attempt to investigate the nature or relations of Ozone, "a delusion and a snare," and the great majority of English and American chemists have seemed disposed to "take him at his word," as its investigation has been by them almost wholly neglected. The whole matter seems to have been left to the researches of a few German and French chemists whose half contradictory results have appeared only in disjointed articles in the foreign periodicals. Indeed but one volume of English authorship, making any pretentions to thoroughness in the matter, has appeared; and even in this the subject is treated in a most fragmental and unsatisfactory manner.

But notwithstanding this disheartening meagerness of knowledge of the nature of Ozone and of the conditions in which it appears, there can be no shadow of a doubt that the relations which it sustains to organic life in every form are of most vital importance, and that we today are more generally indebted for our sanitary well-being to its indirect influence than we have as yet any conception. Now we know this Ozone to be an allotropic form of oxygen. We know it to be commonly produced by the action of electricity on the oxygen of our common air. Its peculiar odor as thus produced has been known from the most remote antiquity. Homer, in his Odyssey, speaks of the atmosphere, after the passage of the thunderbolt, as being "quite full of sulphurous odor," and it is a common experience of those who have happened near a lightning stroke that it is instantly followed by this strong characteristic odor. A positive proof of this fact, however, was furnished by a Swiss scientist, Buchwalder, who, while traveling in the Alps, was overtaken by a violent thunder storm in which his guide was instantly killed by a lightning stroke, and the powerful odor was at once apparent. Shortly afterward he visited the laboratory at Basle, in which Schonbein was manufacturing a large quantity of Ozone for experiment, when he at once expressed his astonishment at the strong "smell of lightning" which he had just observed a few days before in the thunder storm on the Alps. Thus the identity of the phenomena was plainly established. The same odor may be observed around an electrical machine during its op-

eration in a close dry room. The allotropic condition of Ozone, however, is best illustrated by a single experiment. We know that the metal silver remains bright and unaltered in dry oxygen gas. But let a strip of silver be enclosed in a tube of oxygen, and let a succession of electric sparks be passed through, Ozone will be produced and the silver will almost immediately become covered with a black deposit which is nothing else than silver oxide. On heating this black deposit pure oxygen gas will again be given off. The views of Schonbein as to the nature of Ozone are not at the present day generally accepted. He looked upon oxygen as an electrically neutral body made up of an electro-positive and an electro-negative atom. Its condition then pictured itself to his mind as O+O—, standing side by side. By the action of the electric current he considered its particles to become so altered in their mutual positions as to produce two distinct bodies: First, Ozone, represented O—O+O—; second, Antozone, represented O+O—O+.

This view is now, however, wholly abandoned. As to the existence of Antozone it is here entirely unnecessary to speak. It is now looked upon by the generality of chemists as probably nothing else than the per-oxide of hydrogen. Ozone itself is now regarded by leading authorities as merely condensed oxygen, with a density of one and a half times that of oxygen. Hence if we represent a working particle of oxygen by O_2, that of Ozone would be O_3. We would thus give it the equivalent 48. For the purposes of experiment we can produce Ozone by a great variety of methods: By a slow oxidation of phosphorus in a moist and confined atmosphere; by the decomposition of the vapor of sulphuric ether by the agency of a glass rod heated to temperature of 250° F.; or in large quantities by the decomposition of the permanganate of potassium by sulphuric acid. As evolved by all these methods it exhibits its remarkable properties: A colorless gas of a powerful, pungent odor (whence its name, which signifies "odor producer;") exerting a peculiar irritating effect upon the mucous membrane of the throat and lungs; and with the oxidizing characteristics of ordinary oxygen much intensified. It will attack metals and decompose binary salts which it is entirely beyond the power of ordinary oxygen to touch.

Thus much and briefly as to the nature of this remarkable body. Next as to its existence in our atmosphere. This is found by careful experiment to be all but universal, but varying immensely in degree and intensity as determined by surrounding circumstances, particularly the presence or absence of decomposing organic matter. The natural processes which produce Ozone in our atmosphere are most numerous and varied. Its production by atmospheric electricity has already been mentioned, and although the results from this cause are most startling it is not probable that its effects are at all proportionate to that of the numberless silent producers of atmospheric Ozone. Indeed it seems very probable that there is no process in nature in which oxygen is either absorbed or liberated in which there is not a proportionate quantity of Ozone evolved. Meissner has plainly proved that not only in rapid process of combustion, but in the slow process of decay, a certain quantity of Ozone is produced, the greater portion, of course, instantly disappearing when brought in contact with the decomposing matter, but still a recognizable portion escaping undestroyed into the general atmosphere. The mere process of evaporation from large bodies of water is also a most powerful contributor of Ozone to the atmosphere. But above all these, the latest researches in this fascinating field have indicated a third possible and more powerful source still: the process of vegetable growth. We know that the processes of vegetable nutrition depends primarily upon the fixation of carbon, that is, the absorption of carbonic acid from,

and the return of oxygen to, the atmosphere. Now Daubney has proved by careful experiment upon a slow current of air passing over a living plant that the liberated oxygen thus produced was accompanied by indications of Ozone. No matter how minute the amount thus produced, when we consider the enormous extent to which this operation is everywhere in progress, we must look upon it as a most probable and abundant source of Ozone to our atmosphere. This hypothesis, too, enables us to explain certain well known facts in vegetable nutrition otherwise inexplicable. Thus we know that many plants which contain the greatest amount of nitrogen in their composition are not always those which are most benefited by the use of nitrogenous fertilizers. Such plants are almost invariably large-leaved, exposing an immense foliage surface. Hence the query naturally arises whether these plants may not have the power of supplying themselves with nitrogen compounds through the indirect action of the Ozone exhaled from their foliage. We know that this element has the power of oxidizing the nitrogen of the atmosphere first into nitrous and then into nitric acids, which in combination with the atmospheric ammonia might thus be furnished the plant in no insignificant quantity.

But from whatever source produced, it is obvious that by far the larger portion of our atmospheric Ozone must, on account of its intense oxidizing powers, be almost instantly consumed by decomposing organic matter wherever present. Hence is explained the circumstances in which we find the most abundant evidence of its existence. The atmosphere immediately surrounding stables or outhouses, or over decaying refuse heaps will afford not the slightest trace of Ozone; not, we are to understand, that it may not be there produced, but, when formed, it is at once consumed by the oxidizing processes in progress in such localities. Hence we are not surprised to learn that in cities the indications of its presence are much more feeble than in the pure air of the country uncorrupted by organic effluvia. Even in so moderately a populated city as Manhattan, I have found the result of my Ozone observations much less striking than in the fresher atmosphere of College Hill, two miles away. In the atmosphere of Topeka I have found its amount still less. In densely populated, and especially in manufacturing cities, we of course find the diminution more startling still. The city of Lyons, France, has positively afforded not a single indication of the presence of Ozone, and so proverbially is this the fact that it has been dubbed among French chemists, "the town without Ozone."

In comparing the results of diverse seasons also we very naturally find its quantity in winter fully twice that in summer. This is accounted for not only by the fact that in the winter season our electrical conditions are much more energetic and intense, but more especially by the circumstances that the greater portion of the Ozone then produced in the atmosphere remains there undestroyed, the process of oxidation being then nearly at a stand-still and the organic matter of the earth frequently protected by a deposit of snow. For precisely similar reasons we find the reaction for Ozone much stronger at night than during the day. The maximum amount for the entire twenty-four hours is almost invariably just before sunrise; as by the condensation of watery vapor always taking place at that time, the air is freed from its organic impurities. But it is obvious that the amount of Ozone which we can measure in our atmosphere affords not the least indication of the amount which may have been produced there, for it is only possible for us to measure the residuum, that which remains undestroyed by oxidizable matter.

It is to be seriously regretted that the methods for quantitative estima-

tion of Ozone should be so imperfect and so liable to grave error. Numerous methods for such estimations have been devised, the greater proportion of them dependent upon its well-known oxidizing power. It is well known that Iodide of Potassium is perfectly unalterable in oxygen gas. Under the action of Ozone, however, it is instantly decomposed, caustic potassa formed and free Iodine liberated. A test paper has hence been constructed in which wine-red litmus paper is impregnated with a solution of Potassium Iodide and exposed to the action of the Ozone of the atmosphere. The extent to which this paper is blued by the action of the caustic potassa produced affords a basis for determining the amount of atmospheric Ozone present.

For my own use, however, I have preferred a test of Schonbein's own devising. It is dependent on the well-known property which free Iodine possesses of turning starch an intense blue color; a reaction so delicate that it will detect one part in a million. In the manufacture of the test paper I use the proportion, 1 part of Potassium Iodide to 10 of starch; first, boiling the starch in an excess of 200 parts of distilled water, and, when the mixture is cold, adding the Potassium Iodide. In this, strips of unsized paper are soaked and afterward dried carefully in the dark and in air as absolutely free from impurities as possible. As a basis of comparison I employ a color scale, by which the proportion of Ozone, varying from the merest trace to an abundant presence, is indicated by a series of ten corresponding blue colors, gradually deepening from the first to the tenth. Now, on exposing a slip of this prepared paper to the action of the atmospheric Ozone for a period of twelve hours, free Iodine will become liberated in it to an extent proportionate to the quantity of Ozone in that atmosphere. If the exposed slip be then dipped in water, a blue color from the resulting action of the Iodine upon the starch will then be produced, and by comparing this with our color scale the number of the corresponding color may then be recorded as the result of the observation. Thus a basis is formed by which observers in different countries are enabled by the use of these numbers to compare the results of their investigations. As a necessary precaution the test paper must be preserved in the dark, as the action of intense light itself will in time decompose the Potassium Iodide. When exposed also it must be carefully protected from violent wind, from direct sun-light or even from directly reflected sun-light. This I find is easiest to accomplish by suspending the slip in a plain wooden box without bottom and drilled abundantly with holes to allow a free access of air.

Employing this test of Schonbein's as a basis, the observations upon the quantity of Ozone, which for the year past have been in progress at the Agricultural College, have been most interesting and gratifying. They have established beyond a doubt the existence of an abundance of Ozone in the atmosphere of Kansas. While such observations can of course prove of value only when extended through a long period of years, results of great interest have already been obtained. Two series of daily observations have been made. First, a day observation, the result obtained by exposing the paper from 7 a. m. to 2 p. m. Second, a night observation, the result of which is best obtained by an exposure from 9 p. m. to 7 a. m. The relations of the two are well shown in the means of the obesrvations for the month of January. The average of the day records for this month was 6.03; that of the night 7.50. In four observations for the night records of January, the scale gave the maximum number 10. During the succeeding months these numbers slowly decrease. For the month of May, for instance, the daily average has become 5; for that of July it has fallen to 3.53; in August, to 3.77; while in September it has again risen to 4.75; and thus it will go on increas-

ing until the succeeding January. Moreover, during the summer months the difference between the day and night observations becomes less and less, those of the day sometimes even exceeding those of the night.

Probably one of the most extensive series of observations of this character in the United States has been that conducted by the Chemical Department of the State Agricultural College of Michigan, and I have been much interested in noticing by comparison how uniformly the results obtained in Kansas exceed those of Michigan. I here append a table giving the means of the day and night observations in the two States for the first eight months, from January to August inclusive, of the year 1875:

MONTHS	Kansas		Michigan	
	Day.	Night	Day.	Night.
January	6.03	7.50	5.52	5.93
February	5.66	7.82	5.78	6.57
March	5.36	5.88	5.70	6.19
April	5.26	6.25	3.73	8.96
May	5.00	5.00	3.19	4.03
June	6.00	6.00	3.96	3 66
July	3.53	3.28	3.52	3.22
August	3.99	4.00	3.68	3.68

Moreover, this element of Ozone in our atmosphere, while of itself most vitally important, is above all valuable as establishing a pure atmosphere, one practically free from organic effluvia, the acknowledged source of malarial disorders.

But it is obviously entirely beyond either the limits or province of this paper to attempt any consideration of the complex relations of Ozone to health and disease. At some future meeting of this Academy it may perhaps be my privilege to attempt some such discussion. Probably no problem could be mentioned in which the opinions maintained by prominent scientists have been so discordant and so chaotically diverse. By one class of disputants the very possibility is denied of any connection between the presence of Ozone and the prevalence or absence of certain types of disease. On the other hand, by another party equally eminent it is maintained that the relations of this element to sanitary conditions are of most vital and paramount importance; and that it only remains for us to reveal them by careful research. Leading spirits of this latter party have expressed a firm belief in the near proximity of a period of enlightenment, when in addition to piping our dwelling-houses for water and gas, we shall not only add an additional pipe for carbonic acid under pressure to shield us from the dangers of conflagration, but above all a fourth tube for regulating our domestic atmosphere by a well directed stream of Ozone. Indeed it is only recently that a stock company was organized to this end in the city of Chicago, having as its consulting oracle a well-known western chemist, and for its avowed object the manufacture, upon an extended scale, of Ozone for the purification of the private residences, public buildings and sluice-ways and sewers of the most odorous city. Unfortunately, however, the efforts of this company prematurely terminated in a prospectus soliciting purchasers of stock! Enthusiasts in this matter must bear in mind that the presence of an excess of this Ozone is scarcely to be less deplored than its utter absence. It is well known that when existing in the atmosphere in too great an abundance, it occasions attacks of bronchitis and other bronchial disorders. An explanation has been thus suggested by medical authorities of the prevalence of these diseases, in certain seasons, in northern Minnesota.

What is above all now needed is a general series of careful, patient and conscientious observations extending through long periods of years. It

is only from such a foundation of well authenticated facts, that we can hope to deduce results of any importance. The investigators of America are now rapidly awakening to the importance of this work. Earnest observers are beginning thorough records in various portions of the United States. It has been my object to call the attention of the gentlemen of this Academy to the importance of organizing a series of careful records of the Ozonic phenomena of Kansas. To any one disposed to assist in this work I shall take pleasure in furnishing color scales, Iodized paper and record blanks, simply requesting that a copy of these be returned to me at the close of each month for tabulation.

The solution of this question is destined to become, from a chemical standpoint, one of the most important problems of the century before us; but a problem whose solution can only be purchased by long years of untiring study.

Kansas State Agricultural College, October, 1875.

THE NEBRASKA HOT BLUFF.

By Prof. Wm. K. Kedzie, of the Kansas State Agricultural College.

The somewhat startling natural phenomenon to which it is the object of this paper to call attention, is a bluff of the Missouri river, on the northern boundary of Nebraska, and near the village of Ionia. It is also not very far distant from the opposite town of Yankton, Dakota, and has been principally visited and described by prospectors from our latter city.

It is in appearance a quite ordinary river bluff, about a thousand feet in length, one hundred and fifty feet high, and sloping from the river by which its base is washed at an angle of 70 or 75 degrees. By the undermining action of the river a large mass, some five hundred feet long, one hundred feet high, and twenty to thirty feet thick, was some months ago scaled from the face of the bluff and fell to its base, forming a large mass of debris rising at some points fully forty feet above the level of the river. It is this immense fragmental mass which has displayed the striking phenomena so terrifying to the ignorant and superstitious of the neighborhood, and which very beautifully illustrates the important chemical transformations constantly in progress within the earth's crust.

Attention was first called to the peculiarities of this locality by a party of miners who were prospecting for indications of coal veins. On passing over this mass of debris, they found steam escaping from the crevices at every point. The ground was also perceptibly heated, and by placing the ear to the earth a crackling sound was heard proceeding from below. An opening was made in the mass to the depth of two feet, when the heat became so intense as to be scarcely endurable. Upon perforating the heap still further with an ordinary augur, the temperature was found to be rapidly increasing with the descent. An ordinary thermometer with a range of one hundred and fifty degrees was thrust into the augur-hole thus made, when the mercury shot up so rapidly to the top of the tube that it had to be instantly withdrawn to prevent the bursting of the bulb. All these circumstances carefully considered seem to indicate that the temperature of the interior of the mass was fully 212° F. The exterior was, as a rule, coated with a hard incrustation of mineral salts brought up by capillary action from below; on breaking this the interior was found in a fine pulverulent